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# MEANINGS AND THEIR EXEMPLIFICATIONS[1]

THE history of philosophy contains much controversy about the nature and the ontological status of universals or essences or meanings and their relation to particulars or sensible things. Thus Berkeley and Hume and the later Russell have tried their best to be nominalists, denying that there are any such entities as universals either within mind or without it. Conceptualists have told us that there are meanings, but that they are dependent on being meant. Moderate realists have followed Aristotle and have affirmed the existence of universals, within consciousness as concepts, and outside of it as characters (i.e., qualities, properties, or relations) of things. Extreme realists have followed Plato in asserting that universals are independent both of being meant and of being exemplified.

It is the contention of this paper that the facts about universals and their relation to particulars, as distinguished from the theories about them, are fairly simple, and that, if the traditional terminology and the traditional views are abandoned, these facts can be stated in clear, and perhaps persuasive, propositions. To avoid old associations the term "meaning" is used rather than "universal." The nature of meanings, the relations between them, their distinction from and relation to particulars, and their ontological status are in turn discussed. In conclusion, the view thus reached is shown to account for the nature and validity of *a priori* knowledge.

1. The term "meaning" is used throughout to signify that which is or might be meant as distinguished from any act of meaning. Again, as here used, "meaning" means connotative meaning. A meaning is that which is connoted by any term (other than a proper name). Blueness, justness, to-the-right-of-ness, are examples. On the other hand, those entities which are not connotable by any term (other than a proper name) are particulars. This table and my present sense-data are examples.

What meanings we choose to mean is within our choice, because it is we who mean them, and, as Humpty Dumpty told Alice, we can mean just what we choose to mean, neither more nor less. If we are not satisfied with any given set of meanings we can always choose others. Thus, if we are mathematical physicists and find

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that to continue to use that set of meanings called Euclidean geometry to interpret our data makes our formulæ increasingly complex, we can, if we like, interpret these data by another set of meanings, some non-Euclidean geometry. The meanings we choose to mean can be changed at will, but the particulars, which exemplify or fail to exemplify these meanings, are not similarly within our control.

Because of this ability of ours to mean whatever meanings we choose, our meanings can be fully described in finitely specifiable terms. Thus the whole nature of any meaning consists of its defining characters and what these imply. We can be sure of this, because we can mean just what we choose to mean, neither more nor less nor otherwise. The description of a particular, on the other hand, can never be exhausted, for it will be true of that particular that it either exemplifies or does not exemplify every possible meaning whether meant or not. This means that the whole nature of any particular never can be described. But the whole nature of any meaning can be fixed by a definition and what this definition implies. And since it is we who decree this definition and the meaning of implication also, we can determine the whole nature of any meaning *a priori*.

2. The most interesting thing about meanings, and that which distinguishes them most surely from particulars, is a relation which holds between them but between no particulars. This relation is symbolized in *Principia Mathematica* by the inclusion horseshoe. There, however, it is considered in extension. It is this same relation, taken in intension, that is meant here. It is usually called the relation of inclusion, but this, of course, is not to be understood in the spatio-temporal sense, and to avoid this misunderstanding it might be well to call it logical inclusion. One concrete example of it is the relation of species to genus. Another example is the relation of blue to color. Blue bears the relation of logical inclusion to color, means in intension that what is meant by blue includes or implies what is meant by color. This has as one consequence the extensional proposition, all blue things, if any, are colored things, but the intensional proposition remains true whether there are any blue things or colored things or not.

It is true of any meaning whatsoever that it bears either this relation or its converse to some other meaning. No particular bears this relation to any other particular, and hence this is a distinguishing mark of meanings. Nor is the relation between a particular and any meaning which it exemplifies this relation of logical inclusion. The relation of exemplification is symbolized in extension in *Principia Mathematica* by *epsilon*, and there it is

pointed out quite clearly what are the differences in extension between the inclusion horseshoe and *epsilon*. The differences in intension are even more striking. Thus, even though $X$ were the only blue thing in the universe, the relation of exemplification between $X$ and blue is quite different from the relation of logical inclusion between blue and color, for if $X$ ceased to exist and thus did not exemplify blue, blue would still be precisely the same meaning that it was. If, on the other hand, it were false that blue includes color, one at least of these meanings would have to be different. The relation of logical inclusion is intrinsic to the meanings between which it holds, for it can not fail to hold as long as the meanings remain the same. The relation of exemplification, on the other hand, is extrinsic to the meaning exemplified, in the sense that this meaning remains the same whether it is exemplified or not.

What may well serve then as the principle of individuation is the absence of the relation of logical inclusion or its converse to something else. That which neither logically includes nor is logically included in something else is a particular. Whatever bears either relation to something else is a meaning.[2]

3. In spite of the existence of nominalists and behaviorists it ought not to be necessary to defend at length the truth of the proposition, "There are meanings." The confusion in the minds of Berkeley and Hume between imagining and conceiving, and their re-admission of abstract ideas under some other name such as "notions" or "distinctions of reason" have often been noticed. Since the behaviorists' denial of meanings rests on a denial of consciousness, we can not speak authoritatively for them, but for those of us who are conscious, and who do occasionally mean something in intension as well as denotatively, it would seem safe to assert that there are meanings.[3]

[2] Space-time relations are not sufficient to distinguish meanings and particulars. For space-time relations are meaningful only relative to some reference frame and this reference frame is itself composed of particulars. In this sense particulars are logically prior to space-time. Further, space and time relations are simply certain kinds of order among particulars and the same type of order holds among meanings. Compare, for example, the temporal order with the order of the number series.

[3] Perhaps Mr. Russell's apostasy on this point deserves more serious consideration. He points out (*The External World*, pp. 125–126) that when two or more things have a common property, there is a transitive symmetrical relation between them. He urges that it doesn't necessarily follow that whatever such a relation occurs there must be a common property. The class of terms that have the given transitive symmetrical relation to a given term will fulfill all the formal requisites of a common property of all members of the class, and hence there is no need of supposing the latter. But the transitive symmetrical relation is itself a common character of the terms and thus a

Not only are there meanings, but they are independent of exemplification. As was pointed out above, the relation of exemplification is extrinsic to the nature of any meaning. We can entertain that set of meanings known as Euclidean geometry or that set known as Riemannian geometry, and these sets of meanings retain all their intrinsic characters whether the world we live in exemplifies either or neither.

In at least one sense, also, meanings are independent of being meant, namely, in the sense that certain propositions are true about them whether they are meant or not. Thus of any meaning whatever it is true that it might be meant; its being meant is within the realm of logical possibility; and further, if certain events transpire it will be meant. In this sense also, meanings are eternal and unchangeable. They are what they are and have certain definite relations to other meanings whether they are meant or not. Thus the specific nature of the thousandth decimal of *pi* is perfectly definite now, for it is determined by certain meanings which are now meant, though no one happens now to know what it is. If, however, anyone performs certain computations he can find out. Similarly, the relation of any theorem in *Principia Mathematica* to the postulates has always been what Russell and Whitehead have only recently told us it is. Meanings are changeable only in the sense in which Christmas presents are, that is, exchangeable. We can substitute one meaning for another, using, if we like, the same word to signify either. Thus the term "atom" today no longer means what it once meant, though its former meaning remains what it was and could be meant and used again if occasion arose. It is simply due to the ambiguity of our language that the same word may signify different meanings, and different words the same meaning.

4. To sum up, then, the facts about meanings seem to be these.

universal. As Mr. Russell so well points out in his *Problems of Philosophy*, relations as well as qualities are universals, and, as he urges there, if we must admit some universals why should we balk at others?

Again, Mr. Russell and Professor Whitehead disagree at present about the interpretation of *Principia Mathematica*, Mr. Russell taking the symbolic propositions in extension, Professor Whitehead in intension. But elsewhere, (*Introduction to Mathematical Philosophy*, pp. 152 ff), Mr. Russell himself points out that, for purposes of actual inference, the relation of material implication (not-*p* or *q*) must be known without knowing already which of the two alternatives makes the disjunction true, and that this occurs only when "certain relations of form exist between *p* and *q*." These relations of form are intensional relations, universals, or meanings. It seems, thus, that Mr. Russell, even in mathematical logic, which first led him to abandon his extreme realistic position on universals taken in the *Problems of Philosophy*, re-admits them and returns to that same position.

Some people, at least, do sometimes mean meanings. These meanings are independent of exemplification. They are also independent of being meant, and are eternal and unchangeable in the sense that at any time they might be meant, and given certain conditions will be meant, and in the sense that they have certain relations to other meanings, which latter also might be meant.

To the extent that this is what extreme realists mean when they tell us that universals exist or subsist eternally, independent of being meant or exemplified, we must agree with them. With the conceptualists, however, we must agree that the only meanings with which we have anything to do are those which are meant by us. A meaning which no one will ever mean, though it has that sort of being just described, is nothing to us. It is only with those meanings which we mean that we are at any time concerned.

To the moderate realists we must grant that many meanings are exemplified in particulars. In fact, any particular is bound to exemplify, and also fail to exemplify, an infinite number of meanings. This is because every meaning has a contradictory, and what does not exemplify *X* exemplifies not-*X*. It follows that every particular exemplifies and also fails to exemplify an infinite number of meanings. For there are, certainly, an infinite number of meanings; the number series is itself such; and each particular either exemplifies or fails to exemplify each of these meanings, and whichever it does, it does the opposite for that meaning's contradictory.

Only to the nominalism which denies that there are any meanings at all, may we pay no bow of respect. It must be categorized, within Broad's meaning of the term, as a "silly" view, which only an extremely able man would attempt to hold. Our respects are due not to nominalism, but to its defenders.

5. What the view here developed is called matters little if only it states the facts about meanings and their exemplifications both truly and clearly. Some evidence that it does this is afforded by its ability at once to give an account of the validity of *a priori* knowledge, an account in the main similar to that given by Professor C. I. Lewis in *Mind and the World Order*.

*A priori* knowledge is possible because there are meanings which are choosable, unchangeable, independent of exemplification, and which have relations such as logical inclusion to other meanings. Because we can mean any meanings we choose to mean and exclude from our meanings anything we wish, we can determine the whole nature of our meanings and of the relations between them. Because these meanings are eternal and unchangeable, we can be sure that their natures and mutual relations will always

remain the same. Because all meanings include or are included in others, all meanings imply or are implied by others. For if, in intension, *A* includes *B*, then *A* implies *B*. Thus, since the meaning "blue" includes the meaning "color," we know that blue implies color, and that all blue things, if any, are colored things. And because our meanings and their relations are independent of exemplification, no experience can ever invalidate such *a priori* knowledge.

Because of the stress laid in this paper on meanings, and because of the large degree of agreement with Plato, it must not be concluded that it is necessary to agree with Plato on the further point that meanings are more important and real than are their exemplifications. To be sure, nothing meaningful can be asserted of any particular except that it exemplifies some meanings and fails to exemplify others. But this does not imply that only meanings are important or real. For it makes a tremendous difference to us which meanings are exemplified and which are not, whether, for example, in our consciousness we find instances of happiness or of unhappiness. To paraphrase Kant: Meanings unexemplified are empty, i.e., exampleless; particulars exemplifying no meanings are blind, i.e., meaningless.

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## THE APPLICABILITY OF LOGIC TO EXISTENCE

TOWARD the close of an article in this JOURNAL, I remarked that "in spite of the positive character of many assertions that have been made, my prime intent is to raise a question. . . . The basic issue concerns the relation of the logical and the ontological, the formal and the material or existential."[1] The article by Mr. Nagel "Can Logic be Divorced from Ontology?"[2] is welcome for two reasons. In the first place, I am convinced that differences of view on this question are fundamental to many other differences among philosophers, and to such an extent that the nature of these differences can be adequately understood only as the underlying difference from which they proceed is made explicit. Next to actual agreement nothing is more clarifying in philosophic discussion than the location of the source of disagreement. So I hope the article of Mr. Nagel will be the first of a number dealing with this issue.

In the second place, Mr. Nagel's contribution has made me aware

[1] Vol. XXVI, p. 705.
[2] Vol. XXVI, pp. 705–712.

that there was considerable ambiguity of statement in my previous article, so that I did not make my conception of the issue clear, and gave occasion to stumbling on the part of intelligent readers. So I am glad of the opportunity to restate my view of the nature of the problem—which I was more concerned to raise than, in that article, to try to solve. So let me first say that the question of the *relation* of the logical and the existential was intended to be taken in a positive, not a negative, sense. That is, I should answer the question put in the title of Mr. Nagel's article in the negative; I do not think that logic can be divorced from ontology. I agree that logical characters can not be "cut off" from existential (p. 707); that the "ground" of the logical must be found in the ontological (p. 710); that "method must in some sense reflect or refract orders of things that are knowable orders"; that "the continuity between logic and metaphysics can not be broken" (p. 708); and, generally, that "there must be a connection between logic and metaphysics" (p. 709). But these agreements only raise the questions: In what sense? What kind of a continuity is there? What sort of connection holds? There are other relations besides the literal identity or "equating" which I denied. And about Mr. Nagel's answers to these questions I am still in some doubt.

There seem to be two reasons for failure to get the meaning of my previous article. For one of them I am directly responsible. The usual meaning of "apply" is "to bring to bear practically," to use or administer. I employed expressions which contradicted my actual meaning, since my positive point is that logical characters can be employed or brought to bear practically upon other existences, while my negative point is that they do not inherently characterize other existences in such a way as to afford premises on which existential inferences may be directly based. My actual meaning is perhaps expressed in the following sentence: "The significant question is whether there are material or matter-of-fact grounds for *assigning* to actual existences the properties which are designated in the formal propositions" of identity, excluded middle, and contradiction.[3] The principle of contradiction is directly assignable to *Pi* as a logical or mathematical (symbolic) object, so that, as I pointed out, it justifies a direct conclusion—namely, the non-finite character of enumeration of its value. What I was denying was that it had *that* kind of applicability to physical existence, though I had no intention to deny that the mathematical object could be used, or be applicable, in *dealings* with such existence. Rather, the opposite.

The other ground of misapprehension is perhaps that while my

[3] P. 702; italics not in text.

discussion was limited to the three formal "laws," identity, contradiction, and excluded middle (with the emphasis on the latter), Mr. Nagel discusses for the most part the general question. It is true that I said that "the question of the status of contradiction and excluded middle is a phase of a larger question" (p. 705), but confusion may arise when what was said of an included phase is carried over too directly to the larger issue which I refrained from discussing. However, as I have already said, it is the larger issue in which I am most interested, and so I welcome Mr. Nagel's discussion.

## I

He makes some statements that are in line with what I had in mind, however ambiguously I may have expressed my meaning. Thus he says (p. 709) that "logical relations are concerned with the mutual relations of propositions, not with the mutual relations of things," and that "only thinking can be said to be self-consistent, however much that consistency is conditioned by things" (p. 711), and that logic is concerned primarily with "our second intentions of things, with things as objects of reflective thought" (p. 709). Such statements are in strict harmony with my thought. On the other hand, I should not dream of denying either that valid objects of thought are *conditioned* by prior existence or that they are *indirectly* applicable to them by means of operations, themselves existential, which are integral elements in the *complete* object of thought. Without assuming either agreement or disagreement, I shall now proceed to a discussion of issues in the light of some specific points raised by Mr. Nagel.

I begin with the point that lies nearest to the specific content of my original article—the discussion of excluded middle. In reference to the application of the principle of excluded middle to a door as shut or not-shut, he says, "Fix one content, make explicit by pointing to a set of operations of conditions what it is to be shut, and the moving door does or does not meet those conditions" (p. 710). Precisely. Fixing context, defining a set of operations, is just the work of thought. Upon *its* product, then, the excluded middle can be directly brought to bear. This was my point. And as I explicitly pointed out, the resulting definition—the reflectively defined object—is of use or avail in *dealing* with actual existence. What was denied was that *apart* from this work of reflection in fixing content and defining meaning, the properties designated by the excluded middle characterize existence. Mr. Nagel has given a valuable explicit statement of what I called "the ideational and ideal character of 'open' and 'shut'" (p. 705). Instead of the

difficulty being due to "failure to define operationally" the ideas used, the reverse is true. This operational definition is precisely what constitutes the object of thought, and its *absence* from *prior* existence is just why the properties of excluded middle do not characterize, and may not be assigned to, the strictly existential door. Exactly the same point may be made about "low pressure" (p. 711). Mr. Nagel says "while there may not *actually be* low pressure, low pressure is *intelligible*[4] in terms of the operations between existing things." Precisely. I should not desire a better illustration of my meaning.

In the same connection belongs Mr. Nagel's reference to the determinateness of existence. Here he has, unless I err, unwittingly taken advantage of an ambiguity in the term "determinate." When he says "existence is determinately what it is" (p. 710), he is referring to existence as it is apart from connection with the reflectively determined object. The statement, of course, is true, but it has no bearing upon the relation of contingency to excluded middle. For a contingent or indeterminate thing is "determinately what it is," namely, indeterminate. There is no denying that determination in this sense is existential. But such determinateness is a different sort of thing from the determinateness of objects of thought due to fixing a context and defining operations. What I was objecting to—and Mr. Nagel appears to be committed to the same objection—is the direct carrying over of *such* determination to prior existence.

The same considerations apply to the bearing of the excluded middle upon future events. I did not dream of denying that the contingent has elements of definite characteristics, nor that predictions rest upon elements of continuity of existence between present, past, and future. When Mr. Nagel says (p. 712): "A sea fight must either take place tomorrow or not, but it is not necessary that it should take place, neither is it necessary that it should not take place, yet it is necessary that it either should or should not take place," he is pointing out the difference that holds between necessity as directly characterizing existence and necessity characterizing the object of thought. It is the disjunction, the "either-or," that is necessary. Does Mr. Nagel hold that this disjunction inherently characterizes existence, or does he hold that an object of thought which is disjunctively defined may then be brought to bear, through operations, upon existence?

## II

I turn now to the more general consideration. Mr. Nagel points out quite correctly that I have a metaphysics in the sense of attrib-

[4] Italics not in text.

uting certain generic characters to Nature as existent. He points out with equal correctness that as *objects of knowledge* these properties are reflectively arrived at. He then raises the question of the ground or criterion for distinguishing between logical and ontological characters, since both are the results of reflective inquiry involving inference [5] (p. 706).

In general the answer is simple. The distinction is made on the grounds of experience. Reflective inquiries themselves exist and are *had* in direct experience as other things are had. They are then capable of being made the objects of reflective inquiry. When so inquired into, their distinctive properties are ascertained. Thus the criterion does not differ from that used in distinguishing the properties of a cat from those of a dog. If reflective inquiry were not primarily itself an existence, its distinguishing properties could not be empirically determined. If it is such an existence, we can investigate it. Whether its properties are distinctively different from those found in other things is, of course, itself a matter to be decided by comparing the results of the various inquiries. But the present question concerns simply the criterion of distinction, so that it is not necessary to go into that matter here. It may be pertinent, however, to note that in each case the existential assignment of properties, whether to the existence of inquiry or to other existence, is dependent upon the actual performance or execution of indicated operations, the conclusion remaining propositional, or symbolic, short of such application—short of being brought "practically to bear." Does Mr. Nagel hold, for example, that implicatory relations as such characterize existences apart from reflection just as spatial and temporal qualities so characterize them? Discussion of this question would help define the issue.

## III

The previous remarks suggest the answer to the question as to the "ontological status" of logical or intellectual properties, though they do not directly define it. If one takes into account the existence of reflection, then, of course, there is no argument. It is truistic that with respect to this existence, its characteristic properties are ontological—they exist. But this does not settle the question whether they exist apart from reflection, which would be the case were reflection merely a psychological or (better put) pedagogical

[5] I am not sure of the exact implications of Mr. Nagel's own discussion of this point, so I confine myself to the question of the criterion. The source of my inability to understand is his seeming implication (on pp. 706–07) that it follows from what I said that objects of reflection should have *only* logical traits.

process leading to the direct apprehension of things as antecedently possessed of logical properties. It does not settle the question as to whether they are ontological in the sense of being generic metaphysical characters similar to those of contingency, perspectives, heres and nows to which Mr. Nagel refers.

While I deny that they are such genetic antecedent properties, I do not deny that existence, apart from reflection, *conditions* reflection as an existence, nor that the latter has a temporal continuity with prior existences. The union of stability and precariousness is, as I have tried to show elsewhere, a condition of the occurrence of thought, whose ulterior function is, accordingly, to give to other existences a stability or determination they would not possess without it. My position may perhaps be made clearer by a distinction between the potential and the actual. To use a barbarous locution, I hold that existence apart from that of reflection is logi*cible,* but not logi*cized.* Similarly, certain stuffs in nature are ed*ible* but not eat*en* until certain operations of organisms supervene. These operations produce distinctive additive consequences. Through them, qualities and relations previously potential become actualized.

I am at a loss to see why my reference to the formal properties of machines (p. 712) should have seemed incompatible with the position taken in my article. Machines are machines, works of art brought into existence by operations that effect a re-disposition of prior existences. The redisposition that constitutes the machines renders new functions and uses possible; the traits that form the structure on which these functions and uses depend provide characteristic formal properties. But the fallacy of transferring these properties to the material on which machines operate is just the fallacy I was engaged in pointing out.

A loom as a reflectively constructed machine is applied, that is, "practically brought to bear," upon yarn—itself, by the way, a manufactured product. In this operation yarn becomes cloth marked by a pattern. This product has an ontological, that is, existential status. But it does not follow from this fact that the formal properties of the machine characterize inherently either the yarn or the cloth. The analogy to my mind with identity, excluded middle, contradiction, as general characters of the objects that are products of the art of reflection is complete and reasonably obvious. These characters are then applicable, useful, in dealing with other existences through operations they symbolically or intellectually define.

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## BOOK REVIEWS

*The Nature of the Physical World.* A. S. EDDINGTON. New York: The Macmillan Company. Cambridge, England: at the University Press. 1928. Pp. xvii + 361.

*Science and the Unseen World.* ARTHUR STANLEY EDDINGTON. Swarthmore Lecture, 1929. New York: The Macmillan Company. 1929. Pp. 91.

Rare is the man who is an acknowledged master in a great scientific field and who also has mastery of the language in which he writes. Professor Eddington is such a man, and these books are books that only such a man can write. It is no small additional merit of the books that the author succeeds in giving the impression that he goes about his work, not as a bit of drudgery, but as a merry task. He evidently had great fun, as we Americans say, in preparing the larger volume, and consequently he gives the reader the idea that science, in spite of its arduousness, is not a bore, but a blithesome enterprise. But there is another reason for the charm of these books; it finds expression in such a passage as this: "We are anxious for perfect truth, but it is hard to say in what form perfect truth is to be found. I can not quite believe that it has the form typified by an inventory. Somehow as part of its perfection there should be incorporated in it that which we esteem as a 'sense of proportion.'"[1]

Naturally many topics are discussed in the larger book. Roughly they may be classified as follows: The theory of relativity, time and becoming, man's place in the universe, the quantum theory, the limitations of science, and finally, the philosophy that Professor Eddington has evolved as a result of his scientific studies. An adequate review of the book would cover what is said on all these subjects. The present review, of course, does not claim to be adequate. The chapters on relativity (I, II, III, VI, VII) present nothing that the author had not presented earlier in his well-known volumes. The quantum chapters (IX, X) are the clearest popular statement of this difficult subject that I have seen. They close with a few pages (225–229) devoted to pointing out the "New Epistemology" involved in quantum physics. This epistemology condemns the older epistemology as "aiming at a false ideal of a complete description of the world. . . . It has become doubtful whether it will ever be possible to construct a physical world solely out of the know-

[1] *The Nature of the Physical World*, p. 341. All subsequent quotations are from this larger work, except when the page reference is preceded by "*S. U. W.*," i.e., *Science and the Unseen World.* To make sure that I am doing justice to the author's views, I shall quote many passages quite at length.

able. . . . If it is possible, it involves a great upheaval of the present foundations. It seems more likely that we must be content to admit a mixture of the knowable and unknowable. This means a denial of determinism, because the data required for a prediction of the future will include the unknowable elements of the past. I think it was Heisenberg who said, 'The question whether from a complete knowledge of the past we can predict the future, does not arise because a complete knowledge of the past involves a self-contradiction' " (pp. 228–229). The bearing of this on the "free-will" controversy is taken up in a later chapter.

The limitations of science are implied by the method by which science has made its achievements. "We are going to build a World—a physical world which will give a shadow performance of the drama enacted in the world of experience. We are not very expert builders as yet; and you must not expect the performance to go off without a hitch. . . . We take as building materials *relations* and *relata*. . . . To distinguish the relata from one another we assign to them *monomarks*. The monomark consists of four numbers ultimately to be called 'co-ordinates.' But co-ordinates suggest space and geometry and as yet there is no such thing in our scheme; hence for the present we shall regard the four identification numbers as no more than an arbitrary monomark. Why *four* numbers? We use four because it turns out that ultimately the structure can be brought into better order that way; but we do not know why this should be so . . ." (pp. 230–231). And then we proceed to build up a logical structure, the mathematical relations between whose elements are identical with the mathematical relations between the pointer-readings given by our various scientific instruments. Professor Eddington goes on to give a brief summary of the results secured by the method of tensors expounded in detail in his *Mathematical Theory of Relativity*.[2]

The upshot of the world building is that "we reduce the really important measures to 16. These can be divided into 10 forming a symmetrical scheme and 6 forming an antimetrical scheme. This is the great point in the bifurcation of the world." Out of the ten symmetrical coefficients "we find it possible to construct Geometry and Mechanics. . . .We derive from them space, time, and the world-

[2] The reader gets, by the way, a sense of one of the great limitations of exact science; or rather, unless he be a mathematician, a sense of his own limitations in the presence of exact science. Such science can be presented only in mathematical equations. Any popularization of such science is futile, since there is neither popularity nor science when the work of popularization is completed. But the man in the street gets a valuable discipline from reading such a chapter as that on "World Building"; he learns that, whereas the scientist confesses great ignorance of the nature of the physical world, he himself must confess still greater ignorance of the grounds of the scientist's ignorance.

curvatures representing the mechanical properties of matter, viz., momentum, energy, stress, etc." Out of the six antisymmetrical coefficients "we construct Electromagnetism. . . . We derive electric and magnetic potential, electric charge and current, light and other electric waves. We do not derive the laws and phenomena of atomicity. Our building operation has somehow been too coarse to furnish the microscopic structure of the world, so that atoms, electrons and quanta are at present beyond our skill. But in regard to what is called *field-physics* the construction is reasonably complete. . . . We build the quantities enumerated above; and they obey the great laws of field-physics *in virtue of the way in which they have been built.* That is the special feature; the field laws—conservation of energy, mass, momentum and of electric charge, the law of gravitation, Maxwell's equations—are not controlling laws. They are truisms. Not truisms when approached in the way the mind looks out on the world, but truisms when we encounter them in a building up of the world from a basal structure" (pp. 236–237).

We have here, of course, the characteristic of the postulational method in science. The measure numbers we get in *experimentation* are empirical findings; they might have been other than they actually are. Our mathematical equations could not have been other than they are, after we had started out with the postulates that we actually laid down. Once identify the coefficients in these equations with the empirically ascertained measure numbers, and there is a necessity about the laws thus obtained. But this necessity is what mathematical necessity always is according to the prevailing view of mathematicians: *"these laws are mathematical identities"* (p. 237). The author's happy faculty of illuminating his conclusion by an analogy is at its best here. "An aged college Bursar once dwelt secluded in his rooms devoting himself entirely to accounts. . . . One day in looking over his books he discovered a remarkable law. For every item on the credit side an equal item appeared somewhere else on the debit side. 'Ha!' said the Bursar, 'I have discovered one of the great laws controlling the college. It is a perfect and exact law of the real world. Credit must be called plus and debit minus; and so we have the law of conservation of £ *s. d.* This is the true way to find out things, and there is no limit to what may ultimately be discovered by this scientific method. . . . I have only to go on in this way and I shall succeed in understanding why prices are always going up' " (pp. 237–238). The author goes on to say: "I have said that violation of these laws of conservation is unthinkable. . . . But the proviso must be remembered, 'granting that the identification [of their subject-matter] is correct.' The law itself will endure as long as two and two make four; but its

practical importance depends on our knowing that which obeys it. We think we have this knowledge, but do not claim infallibility in this respect" (p. 239). Any one who wishes to obtain a clear idea of what exact science *believes* that it has accomplished as distinguished from what it *knows* that it has accomplished can do no better than read Mr. Eddington's book.

To understand the full import of the limitations of the exact science of nature, as conceived by Professor Eddington, we must turn to his view of sense-experience. In other words we must look at his metaphysics. We are introduced to this metaphysics in the very first paragraph of the Introduction. "I have settled down to the task of writing these lectures and have drawn up my chairs to my two tables. Two tables! Yes; there are duplicates of every object about me—two tables, two chairs, two pens." One of the two tables "has been familiar to me from my earliest years. . . . It has extension; it is comparatively permanent; it is coloured; above all it is *substantial.*" "Table No. 2 is my scientific table. . . . It does not belong to the world . . . which spontaneously appears around me when I open my eyes. . . . It is part of the world which in more devious ways has forced itself on my attention. My scientific table is mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed; but their combined bulk amounts to less than a billionth of the bulk of the table itself. . . . I need not tell you that modern physics has by delicate test and remorseless logic assured me that my second scientific table is the only one which is really there—wherever 'there' may be. On the other hand I need not tell you that modern physics will never succeed in exorcising that first table—strange compound of external nature, mental imagery and inherited prejudice—which lies visible to my eyes and tangible to my grasp. We must bid goodbye to it for the present for we are about to turn from the familiar world to the scientific world revealed by physics. This is, or is intended to be, a wholly external world." No doubt the two worlds "are ultimately to be identified after some fashion. But the process by which the external world of physics is transformed into a world of familiar acquaintance in human consciousness is outside the scope of physics. And so the world studied according to the methods of physics remains detached from the world familiar to consciousness, until after the physicist has finished his labours upon it. . . . It is true that the whole scientific inquiry starts from the familiar world and in the end it must return to the familiar world; but the part of the journey over which the physicist has charge is in foreign territory." "The external world of physics has thus become a world of shadows. . . . In the world of physics we watch a

shadowgraph performance of the drama of familiar life. The shadow of my elbow rests on the shadow table as the shadow ink flows over the shadow paper. It is all symbolic, and as a symbol the physicist leaves it. Then comes the alchemist Mind who transmutes the symbols. The sparsely spread nuclei of electric force become a tangible solid; their restless agitation becomes the warmth of summer; the octave of aethereal vibrations becomes a gorgeous rainbow. . . ." (*Introduction.*) "Take for instance . . . colour in the familiar world and its counterpart electromagnetic wave-length in the scientific world. Here we have little hesitation in describing the waves as objective and the colour as subjective. The wave is the reality—or the nearest we can get to a description of reality; the colour is mere mind-spinning. The beautiful hues which flood our consciousness under stimulation of the waves have no relevance to the objective reality" (p. 94). "The interposed nerve-mechanism would prevent any close association of the mental image with the physical cause" (p. 96).

It is on the assumption of the validity, or at least the provisional validity, of this all-pervading twoness, that Mr. Eddington interprets the findings of the physicist. On this assumption it would seem that no physicist can *actually* measure with objective meter rod or any other objective instrument any member of the objective world, for the reason that his meter rod or other instrument is a part of the familiar world and yields no empirical result except as the result is *seen* or otherwise *observed* in this world, and all seeing or observation is "mind-spinning." His primary data are all got in and from the familiar world. In using these data as symbols referring to the "objective world," he must employ a system of inference, and this system "reduces to mathematical equations governing the symbols, and so long as we adhere to this procedure we are limited to symbols of arithmetical character appropriate to such mathematical equations" (p. 270). "Let us then examine the kind of knowledge which is handled by exact science. If we search the examination papers in physics . . . we may come across one beginning something like this: 'An elephant slides down a grassy hillside. . . .' The experienced candidate knows that he need not pay much attention to this. It is only put in to give an impression of realism. He reads on: 'The mass of the elephant is two tons.' Now we are getting down to business; the elephant fades out of the problem and a mass of two tons takes its place." And so on till "we are left with only pointer readings. If then only pointer readings or their equivalents were put into the machine of scientific calculation, how can we grind out anything but pointer readings? But that is just what we do grind out. . . . The triumph of exact science in

the foregoing problem consisted in establishing a numerical connection between the pointer reading of the weighing-machine in one experiment on the elephant and the pointer reading of the watch in another experiment. And when we examine critically other problems of physics we find that this is typical. The whole subject matter of exact science consists of pointer readings and similar indications. . . . Perhaps you will object that although only the pointer readings enter into the actual calculation it would make nonsense of the problem to leave out all reference to anything else. The problem necessarily involves some kind of connecting background. It was not the pointer reading of the weighing-machine that slid down the hill! And yet from the point of view of exact science the thing that really did descend the hill can only be described as a bundle of pointer readings. (It should be remembered that the hill also has been replaced by pointer readings, and the sliding down is no longer an active adventure but a functional relation of space and time measures" (pp. 251–253). We thus have in all exact physical science "the triple correspondence—(*a*) a mental image, which is in our minds and not in the external world; (*b*) some kind of counterpart in the external world, which is of inscrutable nature; (*c*) a set of pointer readings, which exact science can study and connect with other pointer readings" (p. 254).

A careful reading and re-reading of all the pertinent passages leaves me in the dark as to how this triplicity is logically secured; i.e., as to the *logic* by which (*b*) above got introduced into the solution of the problem. Nor do I see why (*c*) is not in this view, just a subclass under (*a*). I am the more puzzled by reason of the fact that Professor Eddington is an advocate of the philosophy of "mind-stuff" (pp. 276 ff.). He expressly says: "Our view is practically that urged in 1875 by W. K. Clifford—'The succession of feelings which constitutes a man's consciousness is the reality which produces in our minds the perception of the motions of his brain' " (p. 278). The logical difficulties involved in this view have often been pointed out, as for example by Fullerton,[3] and until these difficulties have been successfully met, they seem to constitute a bar to the acceptance of the view by any one who is familiar with them. Karl Pearson tried a way out,[4] but it would appear that his effort was not very successful.[5] He should have given up *physical* nerves and *physical* stimuli, and been content with sensations and images. This would have left

[3] George Stuart Fullerton, *A System of Metaphysics*, New York, The Macmillan Company; London, Macmillan & Co., Ltd., 1904; Chapter XXI, pp. 332 ff.

[4] Karl Pearson, *The Grammar of Science*, London, Second Edition, Adam and Charles Black, 1900.

[5] Fullerton, *op. cit.*, Chapter XXII, pp. 342 ff.

him with *some sensations which are pointer readings.* Professor Eddington has not shown us how he would circumvent these difficulties. He has thus obviously omitted an important chapter from his volume on the *Nature of the Physical World.* This chapter should tell us how we get at "some kind of counterpart," *in the external world,* "of the pointer readings"; how we *do* "grind out anything but pointer readings" and their numerical relations; how, in short, we know that there is a physical world at all. A physicist has a right to assume such a world, but when physicist turns philosopher he should make his philosophical views square logically with his physical assumptions.

To resume the discussion given in the last few pages, I feel distressedly the lack of a clear statement of what Professor Eddington conceives to be the relation of his symbols to what they symbolise. I am left in confusion when I try to interpret into a consistent whole the relevant passages previously quoted. In the shadowgraph performance which physics displays before us "all is symbolic, . . . then comes the alchemist Mind who transmutes the symbols." What is meant by this transmutation? Does it mean (1) a substitution of one set of symbols for another set, for instance the substitution of color for the mathematical expression of an electromagnetic wave-length? This would seem to be the meaning if "the wave is the reality" and "the colour is mere mind-spinning." But this does not comport well with the assertion that (2) "in physics we watch a shadowgraph performance of the drama of familiar life." A shadowgraph performance is a symbol of what it portrays, and here apparently what is portrayed is this drama of familiar life. When further "from the point of view of exact science the thing that really did descend the hill can only be described as a bundle of pointer readings . . . and the sliding is . . . but a functional relation of space and time measures," we seem to have left (3) in physics only pointer readings and functional relations between pointer readings—*all symbolising nothing.* In this case the *objective electromagnetic wave* seems to have disappeared from the scientific picture entirely. Which of the three above interpretations or what possible combination of these interpretations is the one that the physicist wishes us to give when he says: "It is all symbolic, and as a symbol the physicist leaves it"?

Apparently there is here some sort of mystic conviction which challenges the authority of logic. Mind-stuff given and its logical difficulties ignored, mysticism becomes easy of defence (pp. 323 ff.), for mind-stuff exhibits itself in our experience not only as impressions or sensations, but also as emotions and appreciations of significance. We need only a conviction of a "background of

pointer readings" (p. 330), and it would then "seem plausible that if the values that give the light and shade of the world are absolute they must belong to the background, unrecognised in physics because they are not in the pointer readings but recognised by consciousness which has its roots in the background" (p. 330). We may even believe that "there are absolute values; then we can only trust optimistically that our values are some pale reflection of the Absolute Valuer, or that we have insight into the mind of the Absolute from whence come those strivings and sanctions whose authority we usually forbear to question" (p. 331). "Accordingly the conviction which we postulate is that certain states of awareness in consciousness have at least equal significance with those which are called sensations. It is perhaps not irrelevant to note that time by its dual entry into our minds . . . to some extent bridges the gap between sense-impressions and these other states of awareness."[6] "The conviction is scarcely a matter to be argued about, it is dependent on the forcefulness of the feeling of awareness" (p. 334).

In *Science and the Unseen World* Professor Eddington, a Friend addressing the Society of Friends, develops his convictions with a powerful because restrained eloquence that might almost persuade one to be a mystic. This little book, like an exquisite poem, defies review. It must be read to be appreciated. Just one or two quotations will be ventured here; they may reveal the temper of the lecturer and entice to a reading of the whole lecture: "The crucial point for us is not a conviction of the existence of a supreme God but a conviction of the revelation of a supreme God (*S. U. W.*, p. 72). This reads well, but I am at a loss to know what is meant. "Consciousness alone can determine the validity of its convictions. 'There shines no light save its own light to show itself unto itself' " (*S. U. W.*, p. 74). "Religion for the conscientious seeker is not all a matter of doubt and self-questionings. There is a kind of sureness which is very different from cock-sureness" (*S. U. W.*, p. 91).

The reference in the next to the last paragraph above to the "dual entry" of time into our minds brings up the consideration of Professor Eddington's treatment of time. "The great thing about time is that it goes on. . . . In the four-dimensional world considered in the last chapter," dealing with time in relativity, "the events past and future lie spread out before us as in a map. The events are there in their proper spatial and temporal relation; but there is no indication that they undergo what has been described as 'the formality of taking place,' and the question of their doing and undoing does not arise. We see in the map the path from past to future or from future to past; but there is no signboard to indicate

[6] This dual entry of time is a matter which we shall discuss later.

that it is a one-way street. Something must be added to the geometrical conceptions comprised in Minkowski's world before it becomes a complete picture of the world as we know it. We may appeal to consciousness to suffuse the whole—to turn *existence* into *happening, being* into *becoming*" (p. 68). "I shall use the phrase 'time's arrow' to express this one-way property of time which has no analogue in space" (p. 69).

Thus Professor Eddington gives his official support to the criticism often urged against the Minkowskian conception that it ignores one feature (and the most important feature) of time, the feature of being a one-way street, and, as we shall see in a moment, he retorts with a *Tu quoque*. The only difference that is left between time and space is the difference brought out in the author's earlier works: in the equation for interval, time and space appear with different signs; where one is plus the other is minus, and *vice versa*. For Mr. Eddington this is true, not only of the physics of relativity, but also of classical physics, for "the primary laws of physics taken one by one all declare that they are entirely indifferent as to which way you consider time to be progressing, just as they are indifferent as to whether you view the world from the right or from the left (p. 67). "There is no more distinction between past and future than between right and left. In algebraic symbolism, left is $-x$, right is $+x$; past is $-t$, future is $+t$" (p. 66). "The classical physicist has been using without misgiving a system of laws which do not recognise a directed time; he is shocked that the new picture should expose this so glaringly" (pp. 68–69). Even clocks do not give any indication as to the direction of time's flight. All that a clock can do is to tell as between two events, "*how much* later one event is than the other"; it cannot tell "*which* event is the later" (p. 99).

Even when we come to secondary laws which deal with assemblages and not with individual happenings, with probabilities and not with necessities, the same is true—*with one exception. "Nothing in the statistics of an assemblage can distinguish a direction of time when entropy fails to distinguish one"* (p. 79. The italics are Mr. Eddington's own). "Suppose that you have a vessel divided by a partition into two halves, one compartment containing air and the other empty. You withdraw the partition. For the moment all the molecules of air are in one half of the vessel; a fraction of a second later they are spread over the whole vessel and remain so ever afterwards. The molecules will not return to one half of the vessel; the spreading cannot be undone—unless other material is introduced. . . . This occurrence can serve as a criterion to distinguish past and future time. If you observe first the molecules spread through the vessel and (as it seems to you) an instant later the

molecules all in one half of it—then your consciousness is going backwards, and you had better consult a doctor" (pp.71–72). In fact this seems to be the only kind of test that Professor Eddington would allow a psychiatrist to use on his scientific patients. "The law that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much the worse for Maxwell's equations. If it is found to be contradicted by observation—well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation" (p. 74).

Professor Eddington drives home upon his popular audience the importance of entropy in giving the vector character to time by using the shuffling of cards as an illustration. "If you take a pack of cards as it comes from the maker and shuffle it for a few minutes, all trace of the original systematic order disappears. The order will never come back however long you shuffle.[7] Something has been done which cannot be undone, namely, the introduction of a random element in place of arrangement" (p. 63). "In the operation of shuffling cards it seems axiomatic that the cards must be in greater disarrangement at a *later* instant. Can you conceive Nature to be such that this is not obviously true? But what do we here mean by 'later'? So far as the axiomatic character of the conclusion is concerned (not its experimental verification) we cannot mean later as judged by consciousness; its obviousness is not bound up with any speculations as to the behaviour of consciousness. Do we then mean 'later' as judged by the physical criterion of time's arrow, i.e., corresponding to the greater proportion of the random element? But that would be tautological—the cards are more disarranged when there is more of the random element. We did not mean a tautology; we unwittingly accepted as a basis for our thought about the question an unambiguous trend from past to future in the space-time where the operation of shuffling is performed" (pp. 92–93).

Here one might very well question the *axiomatic* character of the conclusion when "later" does not mean "later as judged by consciousness." Axioms—*not* postulates—valid of a Nature *never given in consciousness* are surely dubitable. (Professor Eddington's

[7] "There is a ghost of a chance that some day a thoroughly shuffled pack will be found to have come back to the original order. That is because of the comparatively small number of cards in the pack. In our applications the units are so numerous that this kind of contingency can be disregarded" (p. 64).

philosophical theory should require him, as we have seen, to regard the experience of shuffling cards as an experience of sense-impressions which follow each other *in consciousness,*—not of physical happenings in Nature—and in consciousness there is a direct knowledge of the vector character of the time found within its field. "Consciousness, besides detecting time's arrow, also roughly measures the passage of time," p. 100; my italics.) One may even question the axiomatic character of the conclusion when "later" does mean "later as judged by consciousness." I, for example, am so purblind in this matter that I cannot see that the purely mathematical theory of probability has anything to say as to the *time-order* in consciousness in which the 635,013,559,600 different possible whist hands will appear; nor even do I see that it tells me that there is as much of a *practical chance* that one arrangement will appear in time as any other arrangement. So far as I can see we must make some sort of a *postulate* when we apply the mathematical theory of probability to experienced facts;[8] and when we do, it is *experience* that suggests the successful postulate, unless we are very lucky guessers; and experience does not show that mere guessing is usually lucky. Besides, in shuffling cards, we use a method that experience shows to be fairly successful in *purposely introducing* the random element into the pack. The random element in shuffling does not come of itself. In fact the expression "random element" when used of *cards* has meaning only when reference is had to a *purpose,* namely, the purpose to secure a practically unpredictable arrangement.

Professor Eddington goes on to say: "The crux of the matter is that, although a change described as sorting is the exact opposite to a change described as shuffling we cannot imagine a cause of sorting to be the exact opposite of a cause of shuffling. Thus a reversal of the time-direction which turns shuffling into sorting does not make the appropriate transformation of their causes. Shuffling can have inorganic causes, but sorting is the prerogative of mind or instinct" (p. 93). Is not this a rather dogmatic assertion? There is quite a nice sorting of a certain kind among the

[8] We assume or postulate, for example, that in the time-process of shuffling cards there is nothing that makes for the occurrence of any predesignated combination rather than for any other. All that the purely mathematical theory tells us is that there are just so many different ways in which thirteen of fifty-two different numbers are combinable, and that therefore any specified combination bears a certain ratio to the total number of combinations. This is not a statement of *probability* but a statement of *fact.* By our assumption we turn this statement of fact into a statement of probability. There is no *purely mathematical* theory of *probability.* Professor Eddington, of course, is aware of this, and shows his awareness in a passage to be quoted later, where he says that "we can only speak of 'probability in light of certain given information.'" Pure mathematics seems to know nothing of "random elements."

members of the solar system. Is this obviously the work of mind? One can not but contrast the two following statements: "Travelling backwards into the past we find a world with more and more organisation" (p. 84). "Looking back through the long past we picture the beginning of the world—a primeval chaos which time has fashioned into the universe that we know. . . . The world was without form and almost void. But at the earliest stage we can contemplate the void is sparsely broken by tiny electric particles, the germs of the things that are to be; positive and negative they wander *aimlessly* in solitude" (*S. U. W.*, p. 11; italics mine. This first chapter of the smaller book is interesting reading for our present problem.) "Thus gravitation slowly parted the primeval chaos. . . ." Island universes, star clusters, then stars were separated. "A star journeying through space casually overtook the Sun, not indeed colliding with it but approaching so close as to raise a great tidal wave. . . . By this and similar events there appeared here and there in the universe something outside Nature's regular plan, namely a lump of matter small enough to be cool. . . . Cool matter appears as an afterthought." It was this afterthought, an outcome of the increase in entropy, that produced our solar system as we know it to-day. It would seem, then, as if both entropy and at least *one* kind of organization have *increased together*. Here it would appear as if there had been a gradual sorting that is not the work of a prerogative mind or instinct—unless Professor Eddington is not like "most astronomers" who "if they were to speak frankly, would confess to some chafing when they are reminded of the psalm, 'The heavens declare the glory of God'" (*S. U. W.*, p. 25). I am greatly perplexed.

But let us confine ourselves to the increase of entropy. *Does* entropy increase? This means: Is entropy greater at a *later* time than it is at an *earlier* time? The scientist, of course, answers, "Yes." On what does he base his answer? As a matter of historical fact, he bases his answer on the discovery that the quantity in question is greater at a later time as later is given *in his consciousness* than it is at an earlier time as earlier is given in his consciousness. If his consciousness had not given an arrow to *the time in which he was making his investigation and therefore to the time-order of the discovered facts,* he would have had no empirical reason to say that entropy increases. All he could say would be: At one time entropy has a certain measure; at another time it has a different measure; but *which* time is earlier and which is later there is no means of discovering. There does not seem to be a dual entry of time into consciousness. The time which enters in the case of shuffling cards and in the increase of entropy is not making a dif-

ferent *entry* from that which it makes when we *investigate in consciousness* the shuffling of cards and the increase of entropy.

But all this excitement about the increase of entropy as giving an arrow to time, with the consequent guess at "entropy-clocks in some portion of the brain" (p. 101)—a guess which of course has absolutely no empirical basis—seems strange after Professor Eddington has implicitly confessed in an earlier chapter that time's arrow is given us in signalling. "You will remember that a Seen-Now line, or track of a flash of light, represents the *grain* of the world-structure. Thus the peculiarity of a velocity of 299,796 kilometers a second is that it coincides with the grain of the world" (p. 55). "Neither *matter,* nor *energy,* nor anything capable of being used as a *signal* can travel faster than 299,796 kilometers per second, provided that the velocity is referred to one of the frames of space and time considered in this chapter. . . . We are bound to insist on this limitation of the speed of signalling. It has the effect that *it is only possible to signal into the Absolute Future.* The consequences of being able to transmit messages concerning events Here-Now into the neutral wedge are too bizarre to contemplate. Either the part of the neutral wedge that can be reached by the signals must be restricted in a way which violates the principles of relativity; or it will be possible to arrange for a confederate to receive the messages which we shall send him tomorrow, and to retransmit them to us so that we receive them today! The limit to the velocity of signals is our bulwark against that topsy-turvydom of past and future, of which Einstein's theory is sometimes wrongfully accused" (pp. 57–58; italics mine). Obviously the grain of the world is a grain with direction—a one-way grain—a vector! Of course, any finite velocity suitable for use as signal is in the classical physics also a similar bulwark against such topsy-turvydom. All signalling is, and since 1675 has been known to be, a *dynamic* affair and in any theory is "only possible along a track of temporal relations" (p. 58) and *in only one direction.* It is then hard to see how even the four-dimensional world of Minkowski is left "without any dynamic quality intrinsic to it" (p. 92). "Tying ourselves into verbal knots," we could, instead of speaking of "things *becoming unshuffled*" or "*unbecoming shuffled*" (p. 94), speak of our relativistic messages to our confederates as becoming unsignalled or unbecoming signalled, if it were true that "there is no 'becoming' in the external world which lies passively spread out in the time-dimension as Minkowski pictured it" (p. 92). It is, of course, a matter of indifference whether we *call* the direction from past to future plus or minus; this is a mere matter of convention; but call it as we please, *signals will run only in that di-*

*rection.* Hence "a being from another world who wishes to discover the temporal relation of two events in this world" would not need "to read two different indicators" (p. 99). All that he would need is to stand before an echoing wall with a watch in his hand, and then shout. Even if the hands of his watch showed a greater reading when he shouted than when he got the echo, he would indeed be easily fooled if he did not know which event was the later.

This insufficient review must close with a look at Professor Eddington's treatment of the free-will problem. "The indeterminacy recognized in modern quantum theory is only a partial step towards freeing our actions from deterministic control. To use an analogy—we have admitted an uncertainty which may take or spare human lives; but we have yet to find an uncertainty which may upset the expectations of a life-insurance company. . . . It is one thing to allow the mind to direct an atom between two courses neither of which would be improbable"—an hypothesis which Professor Eddington rejects—"it is another thing to allow it to direct a crowd of atoms into a configuration which the secondary laws of physics would set aside as 'too improbable.' Here the improbability is that a large number of entities each acting independently should conspire to produce the result; it is like the improbability of the atoms finding themselves by chance all in one half of a vessel. We must suppose that in the physical part of the brain immediately affected by a mental decision there is some kind of interdependence of behaviour of the atoms which is not present in inorganic matter. I do not wish to minimise the seriousness of admitting this difference between living and dead matter. But I think that the difficulty has been eased a little, if it has not been removed. To leave the atom constituted as it was, but to interfere with the probability of its undetermined behaviour, does not seem quite so drastic an interference with natural law as other modes of mental interference that have been suggested. (Perhaps this is only because we do not understand enough about these probabilities to realize the heinousness of our suggestion.) Unless it belies its name, probability can be modified in ways which ordinary physical entities would not admit of. There can be no unique probability attached to any event or behaviour; we can only speak of 'probability in the light of certain given information,' and the probability alters according to the extent of the information. It is, I think, one of the most unsatisfactory features of the new quantum theory in its present stage, that it scarcely seems to recognise this fact, and leaves us to guess at the basis of information to which its probability theorems are supposed to refer. Looking at it from another aspect—if the unity of a man's consciousness is not an il-

lusion, there must be some corresponding unity in the relations of the mind-stuff which is behind the pointer readings . . . the atoms will individually be in no way different from those which are without this unity in the background. But it seems plausible that when we consider their collective behaviour we shall have to take account of the broader unifying trends of the mind-stuff, and not expect the statistical results to agree with those appropriate to the structures of haphazard origin" (pp. 313–15). It somewhat startles the reader when a scientist who writes as Professor Eddington does about the supremacy of the second law of thermodynamics, a *statistical* law, should *not* expect statistical results to hold here. He takes his stand on insight; "In the case of the brain I have a deeper insight into the decisions; this insight exhibits it as volition, i.e., something outside causality" (p. 312). Of course, insights are unarguable; all that we can do is to confess to the possession or to a lack of such insight. There does seem, however, to be a difference between finding that volition is outside of causality, and not finding that it is inside of causality. Is it possible that Professor Eddington has interpreted a failure of finding causality in volition into a finding of failure of causality?

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## JOURNALS AND NEW BOOKS

REVUE DE MÉTAPHYSIQUE ET DE MORALE. 37e Année, No. 1. Le dermier enseignement de Nietzsche: *Ch. Andler.* La chimie physique: *J. Perrin.* Le rationalisme et l'idée de Dieu: *D. Parodi.* A la recherche de la Société: *J. Renauld.* Les notions de droit et de justice: *P. Tisset.* Le journal métaphysique de Gabriel Marcel: *J. Wahl.* Socialisme et Propriété: *G. Gurvitch.*

REVUE PHILOSOPHIQUE. 55 Année, Nos. 3 et 4. Les éléments esthétiques de la moralité: *J. De Gaultier.* Le sentiment de ressemblance: *D. Parodi.* Comment l'action schématise: *Revault d'Allonnes.* La théorie du feu d'après Boerhaave: *Hélène Metzger.* Les aspects de la justice selon Proudhon: *G. Guy-Grand.*

Adler, Alfred: Problems of Neurosis. With a Prefatory Essay by F. G. Crookshank. Edited by Phillippe Mairet. New York: Cosmopolitan Book Corp. 1930. v + 244 pp. $3.00.

Barthel, Ernst: Die Welt als Spannung und Rhythmus. Erkenntnistheorie, Ästhetik, Naturphilosophie, Ethic. Leipzig: Robert Noske. 1928. xviii + 411 pp. 17 M.

Bose, Manindra Mohan: The Post-Caitanya Sahajiā Cult of Bengal. Calcutta: University of Calcutta. 1930. xviii + 320 pp.

Broad, C. D.: Five Types of Ethical Theory. (International Library of Psychology, Philosophy, and Scientific Method.) New York: Harcourt Brace & Co. London: Kegan Paul, Trench, Trubner & Co., Ltd. 1930. xxv + 288 pp. $4.50.

Downey, June E.: Creative Imagination. Studies in the Psychology of Literature. (International Library of Psychology, Philosophy, and Scientific Method.) New York: Harcourt, Brace & Co. London: Kegan Paul, Trench, Trubner & Co., Ltd. $3.75.

Meyerson, Emile. Identity and Reality. Authorized Translation by Kate Loewenberg. (Library of Philosophy.) New York: Macmillan Co. 1930. 495 pp. $5.00.

Meyerson, Emile: Identität und Wirklichkeit. Deutsch von Kurt Grelling nach der 3. Auflage des Originals. Eingeleitet und mit Anmerkungen versehen von Leon Lichtenstein. Leipzig: Akademische Verlagsgesellschaft M.B.H. 1930. xl + 534 pp. 24 M.

Nicholas de Cusa. De la Docte Ignorance. Traduction de L. Moulinier. Introduction par Abel Rey. (Textes et Traductions pour Servir à l'Histoire de la Pensée Moderne.) Paris: Félix Alcan. 1930. 229 pp. 20 frcs.

Piéron, Henri: Le Développement Mental et l'Intelligence. (Bibliothèque de Philosophie Contemporaine.) Paris: Félix Alcan. 1929. 95 pp. 10 frcs.

Rosny, J. H., aîné.: Les Sciences et le Pluralism. (Nouvelle Collection Scientific.) Paris: Félix Alcan. 1930. Nouvelle édition. xiv + 217 pp.

Siebzehntes Jahrbuch der Schopenhauer Gesellschaft für das Jahr, 1930. Heidelberg: Carl Winter's Universitätsbuchhandlung. 1930. xv + 402 pp.

Reininger, Robert: Das Psychophysische Problem. Zweite, Verbesserte Auflage. Eine erkenntnistheoretische Untersuchung zur Unterscheidung des Physischen und Psychischen überhaupt. Wien und Leipzig: Wilhelm Braumüller. 1930. vii + 292 pp. 13.50 M.

Stoll, Marion Rush: Whewell's Philosophy of Induction. Privately printed. 1929. iv + 125 pp.

Torrey, Norman L.: Voltaire and the English Deists. (Yale Romantic Studies. Vol. I.) New Haven: Yale University Press. 1930. x + 224 pp. $2.50.

Williams, Gardner: The Human Perspective. Being an Interest Theory of Value. Privately printed. 1930. 63 pp. 60 cents.

## NOTES AND NEWS

The editorial staff of *Scientia* announces the death, on February 9 at Milan, of their editor, Eugenio Rignano, Professor of Theoretical Philosophy at the University of Milan.

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We have received the program of the Hegel Congress to be held at The Hague, Holland, between April 22 and 25, 1930.

The Congress will open on the evening of April 22 with a reception to guests by the Hague Committee. The meetings will begin the next morning with an address of welcome by Dr. H. A. Kindermann (Hilversum), and an opening address by Professor Richard Kroner (Kiel). They will be followed by reports on the importance and valuation of Hegelian philosophy, in Italy by Prof. Calogero (Rome), and in England by Professor J. A. Smith (Oxford). The afternoon meeting will consist of reports on the importance and valuation of Hegelian philosophy, in Germany by Dr. Hermann Glockner (Heidelberg); in France by Professor A. Koyré (Paris); and in Holland by Dr. B. M. Telders ('s-Gravenhage).

On the morning of April 24, there will be an address by Professor J. Binder (Göttingen) on "Die Freiheit als Recht" and an address by J. Hessing (Bennekom) on "Die Freiheit als Denken." The afternoon meeting will consist of a discussion of the founding of an International Hegelian Association, followed by a reception to the guests by the Mayor of The Hague at the Rathaus. Foreign guests will be entertained at dinner by the Dutch members of the Congress.

Communications may be addressed to the secretary, Jhr. H. De Brauw (v. Boetzelaerlaan 86, The Hague). Professor Ing. J. G. Wattjes (Delft) is Chairman of the Congress.

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To remember Josiah Royce, the Philosophical Union and its friends will gather in Josiah Royce Auditorium of the University of California at Los Angeles, Sunday, March 30, at three-thirty o'clock. Professor John Dewey will deliver the principal address.